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1 242 065

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(54) SUPPORT STRUCTURES FOR NON-METALLIC FILTER ELEMENTS

(71) We, UNITED KINGDOM ATOMIC ENERGY AUTHORITY, London, a British Authority, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to support structures for non-metallic filter elements of the candle type, that is in the form of elongated tubes, of filter material, one end being open and the other closed.

The invention also relates to filter assemblies comprising such structures together with a non-metallic filter element and to filter vessels enclosing a series of said structures or assemblies.

Candle type filter elements of carbon are attractive for use in high temperature corrosive conditions but they have the disadvantage of a low thermal expansion when compared with that of necessarily associated structural metal, like steel. They also have a low tensile strength and can break with vibration. In current practice, spring loading of carbon candle filter elements is adopted to deal with differential thermal expansion problems. The use of springs tend to complicate structures, makes replacement of filter elements difficult, limits the temperature, is quite unsuitable for use in the context of a gas like hydrogen fluoride, and does not assist vibration problems.

The present invention is directed to effecting improvements over known sprung structures for non-metallic filter elements of the candle type.

The present invention provides a support structure for a candle filter element, comprising a lower plenum chamber having a port in the central region and means around said port for locating the open end of an upwardly extending candle filter element, and further ports, outside the central region, for connection with upwardly extending gas flow tubes, a locating plate for the closed end of the filter element, and gas flow tubes connecting with said further ports and extending upwardly through holes with clearance in the locating plate and terminating at a gas outlet manifold.

A support structure embodying the invention will now be described with reference to the drawings accompanying the provisional specification wherein:—

Figure 1 is a general view in section of a filter vessel, enclosing a series filter assemblies each comprising a support structure with a filter element,

Figure 2 is a longitudinal sectional view of a support structure with a filter element.

Referring to the drawings in the constructions shown in Figures 1 and 2 there is a filter vessel 1 forming part of the gas exit manifold of a fluidised bed reactor used to convert uranium dioxide to uranium tetrafluoride by fluidisation with hydrogen fluoride gas. Vessel 1 contains eight filter assemblies 2 which separate the gas coming from the fluidised bed reactor from any solid material carried over from the fluidised bed

As shown in Figure 1 each filter assembly 2 has a pin 3 extending downwards from its lower end, to locate it in an upstand 4 carried by a filter assembly locating ring 5 which is mounted on a grid 6 secured to the walls of the vessel 1. The upper end of each filter assembly has a gas outlet manifold 7 with an outlet flange 8 which is connected to a flange 9 of a gas offtake conduit 10. The offtake conduit 10 extends through the wall of the vessel 1 and conducts filtered gas to a filtered gas offtake manifold (not shown). The conduit carries the weight of the filter element support structure with the pins 3 serving a locating function.

As shown in Figure 2 the gas outlet manifold 7 of each filter assembly 2 is mounted on a circular plate 11. Tubes 12, 13 and 14

extend upwardly from ports in a lower plenum chamber 15, these ports being outside the central region of the chamber 15. The tubes pass through holes 25, with clearance, in a filter locating plate 29 and similarly through apertures 11*a* in the plate 11 and terminate at the gas outlet manifold 7.

The upper surface of the plenum 15 has two upstanding circular flanges 16 and 17 extending concentrically around a centrally located port 18. Flanges 16 and 17 provide means for locating the open end of an upwardly extending carbon candle filter element 19, having its open end fitted over the aperture 18. Carbon cement is used to seal the joint between the outer surface of the carbon filter element 19 and the inner surface of flange 17. Extending downwards from the centre of the lower surface of the plenum 15 is the pin 3.

In addition to the support for the carbon filter element 19 provided by the tubes 12, 13 and 14, a further support in the form of a removable tie rod 20 is provided. The tie rod 20 comprises a hollow tube 21, the upper end of which extends into a further aperture 11*a* in the plate 11 and the tube 21 is welded to the head of a bolt 22 inserted in the tube 21. The lower portion of the tube 21 extends into a bush 23 in the plenum 15 where it is welded to a stud 24. The stud 24 extends downwards through the bush 23 and is fitted with nuts 26 and 27. The closed end of the carbon filter element 19 is located in a circular flange 28 attached to the underside of the locating plate 29 and is sealed to the inner surface of the flange by carbon cement. The tie rod 20, like the tubes 12, 13 and 14, extends with clearance through an aperture 25 in the plate 29. Thus the element 19 can expand and contract at its own rate without interference from tubes 12, 13 and 14. Under cold operating conditions movement of the guide plate 29 may be prevented by the fitting of a U-bolt 30, to one of the tubes 12, 13 or 14, the arms of the bolt extending through apertures in a strap 31, which is secured on the arms of the U-bolt 30 by nuts 32.

In operation the gas to be filtered passes through the walls of the carbon filter element 19 to the interior of the filter element and in doing so any solids it may be carrying are filtered out. The filtered gas enters the plenum 15 through the port 18 and then flows up the three tubes 12, 13 and 14 into the outlet manifold 7 and then out of the reaction vessel 1, via the offtake conduit 9 into the filtered gas offtake manifold.

The carbon filter element 19 may be replaced by withdrawing the tie rod 20, raising the guideplate 29 to its fullest extent and thereby breaking one cement bond and removing the existing filter element by breaking the other cement bond and replacing it with a new filter element. The joint between the open end of the new filter element and the inner surface of the flange 17 is sealed with carbon cement. The guide plate 29 is then lowered on to the closed end of the filter element, which engages the internal surface of flange 28 and is sealed to it with carbon cement. The tie-rod 20 is then replaced and secured in position.

The amount of solids entrained in the pores of the carbon filter element 19 will increase with use and will effectively reduce the gas flow rate through the walls of the filter element. In order to restore this gas flow rate, gas blow-back facilities are provided to remove the bulk of the entrained solids from the pores of the carbon element, and return them to the fluidised bed.

WHAT WE CLAIM IS:

1. A suport structure for a candle filter element, comprising a lower plenum chamber having a port in the central region and means around said port for locating the open end of an upwardly extending candle filter element, and further ports, outside the central region, for connection with upwardly extending gas flow tubes, a locating plate for the closed end of the filter element, and gas flow tubes connecting with said further ports and extending upwardly through holes with clearance in the locating plate and terminating at a gas outlet manifold.

2. The structure as claimed in Claim 1, wherein a removable tie member extends upwardly from the lower plenum chamber to the outlet manifold.

3. The structure as claimed in Claim 2 wherein the tie member is a tie bolt which terminates at its upper end at a second plate to which is joined the outlet manifold and the gas flow tubes pass with clearance through holes in said second plate.

4. The structure as claimed in Claim 1 wherein said lower plenum chamber has a central downwardly extending locating pin.

5. A filter assembly comprising the structure of any preceding claim in combination with a candle filter element having its open end located over the port in the central region of the lower plenum chamber and its closed end located against said locating plate.

6. The assembly of Claim 5 wherein said filter element is of carbon.

7. A filter vessel having a lower inlet region incorporating a grid and located in said grid a number of support structures as claimed in any of Claims 1-4 or a series of filter assemblies as claimed in Claim 5 and gas off-take conduits extending through the wall of said vessel in its upper region connected inside the vessel with the gas outlet manifolds of the structure.

8. A filter vessel as claimed in Claim 7 as dependent on Claim 4 wherein the gas

off-take conduits by the weight of the filter element support structures and said locating pins locate the bottom ends of the support structures in the grid in the lower region of the vessel.

9. A suport structure for a candle filter element substantially as hereinbefore described with reference to Fig. 2 of the drawings accompanying the provisional specification.

10. A filter vessel in combination with filter assemblies substantially as hereinbefore described with reference to the drawings accompanying the provisional specification.

11. A filter vessel according to Claim 7, as dependent on Claim 5, or according to Claim 10 in combination with a fluidised bed reactor for converting uranium dioxide to uranium tetrafluoride by fluidisation with hydrogen fluoride gas.

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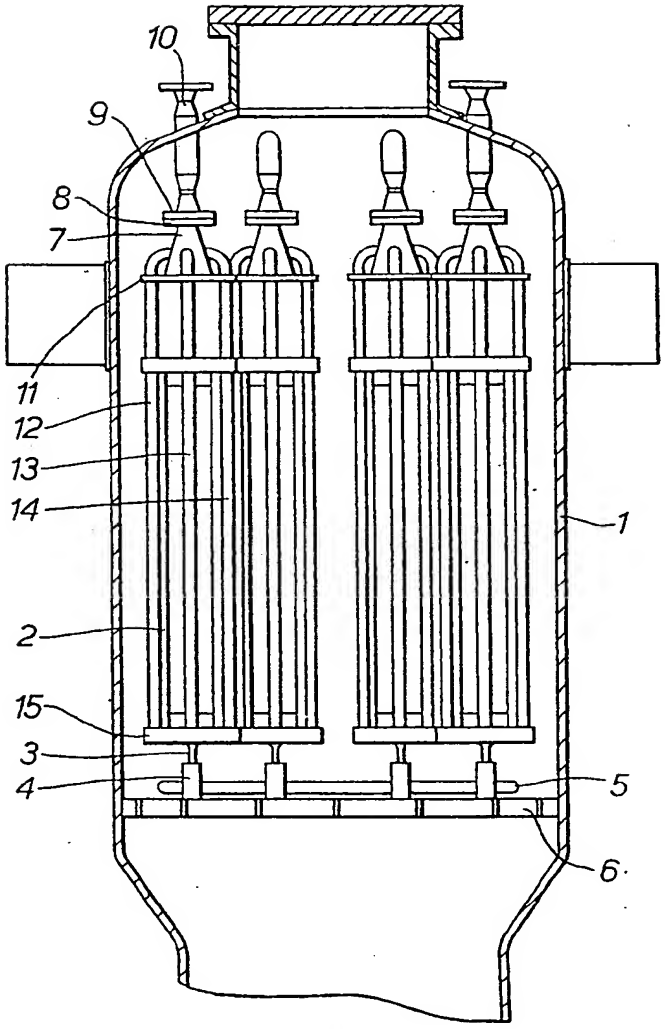
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

FIG.1.



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Sheet 2

FIG.2.